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down to that of the fathers of modern chemistry, Lavoisier, Priestley and others, but not including their works. Those who know nothing of chemistry will find this account entertaining. The illustrations will add to its interest.

North American Moths.*—The 8th and 9th parts of Mr. Stretch's interesting illustrations, completing vol. i, have appeared with three plates, the last of larvæ, some of them only tolerably well drawn, but of great interest. Though the work is partly a compilation, yet much original matter is incorporated, and it is the only manual we have of the most interesting portion of our moth-fauna. Several new species, western and Pacific, are described and figured.

BOTANY.

Investigations respecting the fertilization of Abutilon.—The complete sterility of certain plants with pollen from the same flower (*Corydalis cava*), or even from all flowers from the same stock (species of Abutilon, Bignonia, Oncidium, etc.), is only a remarkable case under the law that self-fertilization gives rise to weaker descendants than crossing. And, further, this law, of which a proof is afforded by every flower which, through the attraction of odor or color, invites bees or butterflies to the enjoyment of honey, and thereby to the accomplishment of crossing, is only a particular case under the more general law, viz ;—that close breeding in-and-in between near relations is productive of mischief; for speaking of individual cases, anthers and pistil of the same individual plant, or the same flower, are the closest conceivable relatives.

A still more general scope can be given to the last law if we comprise in it, also, the diminution of fertility, which, in all degrees even to complete sterility, occurs as a consequence of close relationship of the plants crossed, and in the union of hybrids. Every plant, so to speak, requires for the production of the strongest possible and most prolific progeny, a certain amount of difference between male and female procreative elements which unite. Fertility is diminished as well when this degree is too low (in relatives too closely allied), as when it is too high (in those too little related). The complete accord between "illegitimate" descendants of dimorphous and trimorphous plants on the one side, and hybrids of different species on the other side, authorizes in fact such a grouping together under a common point of view of kinds of infertility occasioned by opposite causes. It is self-evident that the fact can be merely expressed, but not explained. Likewise, naturally, only one of the many relations conditioning the greater or less fertility of a union can be expressed.

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* Illustrations of the Zygænidæ and Bombycidæ of North America. By R. D. Stretch. Vol. i, parts 8 and 9 (and last). San Francisco, Cal., 1874. 8vo., pp. 185-242.

In a species the greater the difference of sexual elements, requisite to the attainment of the highest degree of fertility, the greater will be, in general (*cœteris paribus*), the difference between the plants which can produce offspring with each other. In other words, species which, with pollen of the same stock, are wholly sterile, and even with pollen of nearly allied stocks are more or less infertile, will generally be fertilized very readily by the pollen of another species. The self-sterile species of the genus Abutilon, which are, on the other hand, so much inclined to hybridization, afford a good example of this theory, which appears to be confirmed, also by Lobelia, Passiflora and Oncidium.

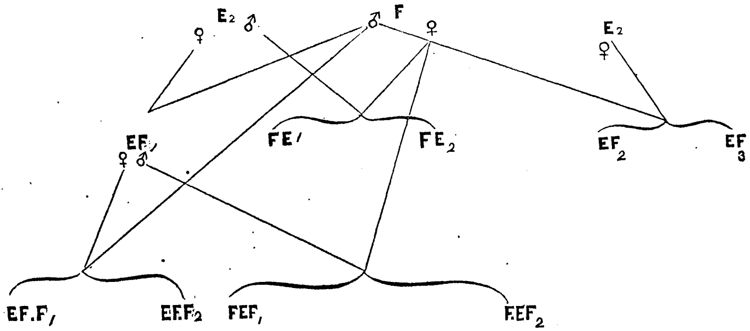
I will not further present these general observations. They merely indicate in what sense, and in what connection I have wished to look upon the following example of infertility between near relations.

In the following *A. C. E. F. M. P.* denote six indigenous species of Abutilon. . . . . . For indicating the simple hybrids the letters of the united species are placed in juxtapositon without other signs, and the *maternal* species *first*. Thus *EF* stands for a hybrid whose mother is *E* and whose father is *F*. In the case of union of these simple hybrids among themselves or with simple species, a point is placed between the symbol of the mother, and that of the father following; *F. CF* had, consequently, *F* for the mother, *CF* for the father; *CE. S* had *CE* for the mother and *S* for the father. Numbers placed under and at the right of the letters denote the individual stocks of a species or a hybrid; FS_1 FS_2 FS_3 are, for example, three different stocks of the hybrid *FS*.

The four plants $EF.\ F_1$, $EF.\ F_2$, $F.\ EF_1$, $F.\ EF_2$ are brothers and sisters, having had the same parents *F*, and EF_1.

Nine flowers of $F.\ EF_1$ dusted with pollen of other flowers of the same stock produced not a single fruit.

Twenty flowers of $F.\ EF_1$ dusted with pollen of $F.\ EF_2$, $EF.\ F_1$, and $EF.\ F_2$, produced three fruits with an average of 1·3 seeds.



On the other hand there were the following results with

								Seeds.
10	Flowers	$F.\ EF$	impregnated	by	FE, and FE_2	10	fruits	4·5
11	"	"	"	"	EF_2 " EF_3	10	"	4·6
10	"	"	"	"	F	9	"	4.6
6	"	"	"		$F.\ CF_1$ and $F.\ CF_2$	6	"	4·5
1	"	"	"	"	FS_1	1	"	4.7

The results following the dusting of the brothers and sisters were not owing to the bad behavior of the pollen since on other plants it was completely potent; the pollen or $F.\ EF_2$ produced fruit rich in seeds in the plants FS_1, that of $EF.\ F$, on FE_2, that of $EF.\ F_2$ on F. Also the pollen of $F.\ EF_1$, produced numerous seeds which so far as sown appear capable of germinating, from the plants $F.\ F$, CF_2, FS_1, and FS_2.

The seeds produced by $F.\ EF_2$ and $F.\ EF$ have, moreover, germinated and given strong plants which, up to this time, have kept pace in growth with those from EF_2, F, $F.\ CF_2$, and FS_1.

The foregoing examples show that in hybrids of Abutilon, and probably so in pure species of the genus, there are many cases of more or less complete infertility between nearly related plant-stocks, between parents and children, between brothers and sisters and even half brothers and sisters. If the foregoing exposition of the connection between relationship and fertility is correct, we may hope to indicate in other plants similar instances of diminished fertility through too near relationship, but we may expect to find complete sterility between relations in those species only which like Abutilon are infertile with pollen of the same stock. . . . .

Darwin, with his accustomed keenness of vision, has expressed* the conjecture that this diminution of fertility, observed so many times, is not a consequence of their hybrid nature, but of too close breeding in-and-in, and I am glad to be able to offer, in the examples of diminished fertility and complete sterility as a consequence of too close breeding in-and-in, in Abutilon-hybrids, herewith communicated, a new proof of the accuracy of Darwin's hypothesis. —*From the German of Fitz Müller*, *Itajhy*, *Oct.*, 1872. G. L. G.

The Fertilization of Gentians by Humble Bees.† —The fringed gentian (*Gentiana crinita*) resembles the above in having erect flowers and the stamens below the stigmas. The fringed lobes of the corolla spread at right angles. Humble bees work upon this very much as they do upon Andrews' gentian.

There seems to be almost no end to the various contrivances by which flowers are fertilized by insects. Flowers closely allied, of the same genus, are fertilized in different ways, so it is not safe to make general rules. We may think that insects will act in a certain way, according to our notion, but after carefully watching them, we shall often see that they are not doing as we supposed they would. We need many patient observers for many years yet, to repeat observations made on this subject and to make new ones; we want to know how our insects behave upon every species of flower from the time they first visit it, to the time it affords no nectar to attract them.—W. G. Beal, *State Agricultural College*, *Lansing*, *Michigan*, *Nov.* 8, 1873.

ZOOLOGY.

Gigantic Cuttle-fishes of Newfoundland.—It seems, as will be seen by the following correspondence, that we were incorrect in saying that the first letter of Mr. Murray on this subject was addressed to the late Prof. Agassiz (p. 120). It was in fact written to Prof. Marcou. We make reparation for the inadvertency by publishing the following letters from Prof. Agassiz, of which copies have been furnished us by Prof. Marcou. They are

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* Orig. Sp., 4th ed., 295.

† By an oversight omitted from the note on p. 180.